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VARIAN ENGINEERING
REPORT NO. 101-22

COPY NO. 6

VARIAN ASSOCIATES
611 Hansen Way
Palo Alto, California

PROGRESS REPORT

RUGGED X-BAND LOCAL OSCILLATOR

V-52 KLYSTRON DEVELOPMENT

For Period: 1 September to 30 September 1953

Prepared for

Bureau of Ships Navy Department

on

BuShips Contract NObsr-52503
Index No. NE-110420

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OCTOBER 1953

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PURPOSE

The original purpose of the program engaged under BuShips Contract NObsr-52503 was to develop a rugged local oscillator to comply with the Bureau of Ships Contract Specification SHIPS-O-419, dated 15 March 1951, which was subsequently modified at a conference held at the Bureau of Ordnance, Washington, D.C. on 20-21 May 1952 and later at a conference held at Varian Associates on 29-30 September 1952. The tube was to be a reflex klystron operating in the frequency range from approximately 8.5 to 9.6 kmc, and its performance was to be similar to the 2K25 except for severe restrictions on frequency drift with temperature, frequency change due to shock, and FM noise due to vibration.

An amendment to Contract NObsr-52503 executed on 10 July 1953 changed the scope of this contract to incorporate additional development work, as follows:

I. Additional design work in connection with the prototype tube meeting the "1000-Tube Production Refinement Order Specification."

II. Long-range extended development including:

A. Broadband matching to load: Elimination of the matching screw in the output iris to simplify the use of the tube.

B. Conduct an investigation to improve repeller or modulation sensitivity and reduce sensitivity variations over the frequency range and from tube to tube.

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C. Elimination of undesirable modes.

D. Increase mechanical tuning range from 8.8 - 9.6 kmc to 8.5 - 9.6 kmc.

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PROGRESS

During the past month, the effort on this contract has been divided between three major problems. These were: (1) temperature compensation; (2) the new mechanical design, in which the tube is brazed to a portion of the external cavity, and this, in turn, is bolted to the remainder of the external tuner[1]; and (3) the problem of broadband matching to the load.

As mentioned in last month's report, the problem of obtaining uniform frequency-temperature compensation over the tuning range is fairly well understood; however, there is still a wide variation in the amount of compensation obtained from tube to tube. A major improvement had been achieved in August by tightening the tolerances on the fit of the components of the tube before they are brazed together and by controlling the amount of solder used in the braze.

During the past month, the problem was pursued further by building six special tubes with steel rather than kovar reflector shells. The kovar reflector shell was used to reduce the change in reflector position due to thermal expansion. It was believed that the difference in expansion between the steel tube body and the kovar reflector shell was warping the reflector header (see Figure 1). The effect of this warping was to cause negative drift as the tube warmed up, since the grids were moved closer together. Tests on the six special tubes showed that this was definitely the case, and in spite of the loss of reflector compensation, the six tubes were all

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1 Varian Engineering Report No. 101-21

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overcompensated. However, probably due to a bimetallic action at point A of Figure 1, there was still a wide variation in drift from tube to tube. In general, to reduce these variations it appears necessary to eliminate any bimetallic expansion effects which bend or bow portions of the tube. During the next period, additional tubes will be built with steel reflector shells in which the warping of the reflector seal will have been eliminated.

To date, seven tubes of the new mechanical design have been built and tested. In the future, these tubes will be designated as VA-158. Three of the seven tubes have been built with the window tab replaced by an adjustable screw. Tests on these have provided valuable data on the effects of changing the coupling between internal and external cavities. With proper adjustment of the window screw, it is possible to extend the tuning range to 8.5 - 9.6 kmc. There is, however, a general deterioration of all of the operating characteristics at the low-frequency end of the tuning range. The data indicate that by proper redesign of the external cavity the characteristics could be made considerably more uniform over this range. These changes are planned in the near future.

The thermal data on the VA-158 are still not complete. However, it is apparent that warm-up drift is considerably more repetitive in this tube than in the V-52.

A series of measurements has been started to determine the output coupling characteristics of the V-52 and the VA-158. It is hoped that these data will lead to a broadband matching structure for these tubes.

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PROGRAM FOR NEXT INTERVAL

In an effort to determine the causes of variation in temperature compensation from tube to tube, more tubes will be built with steel reflector shells in which warping of the reflector seal will have been eliminated.

Measurements will continue to be made to determine the output coupling characteristics of the V-52 and the VA-158.

Estimated expenditures during September 1953: $4600.00

Estimated man-hours during September 1953: 430

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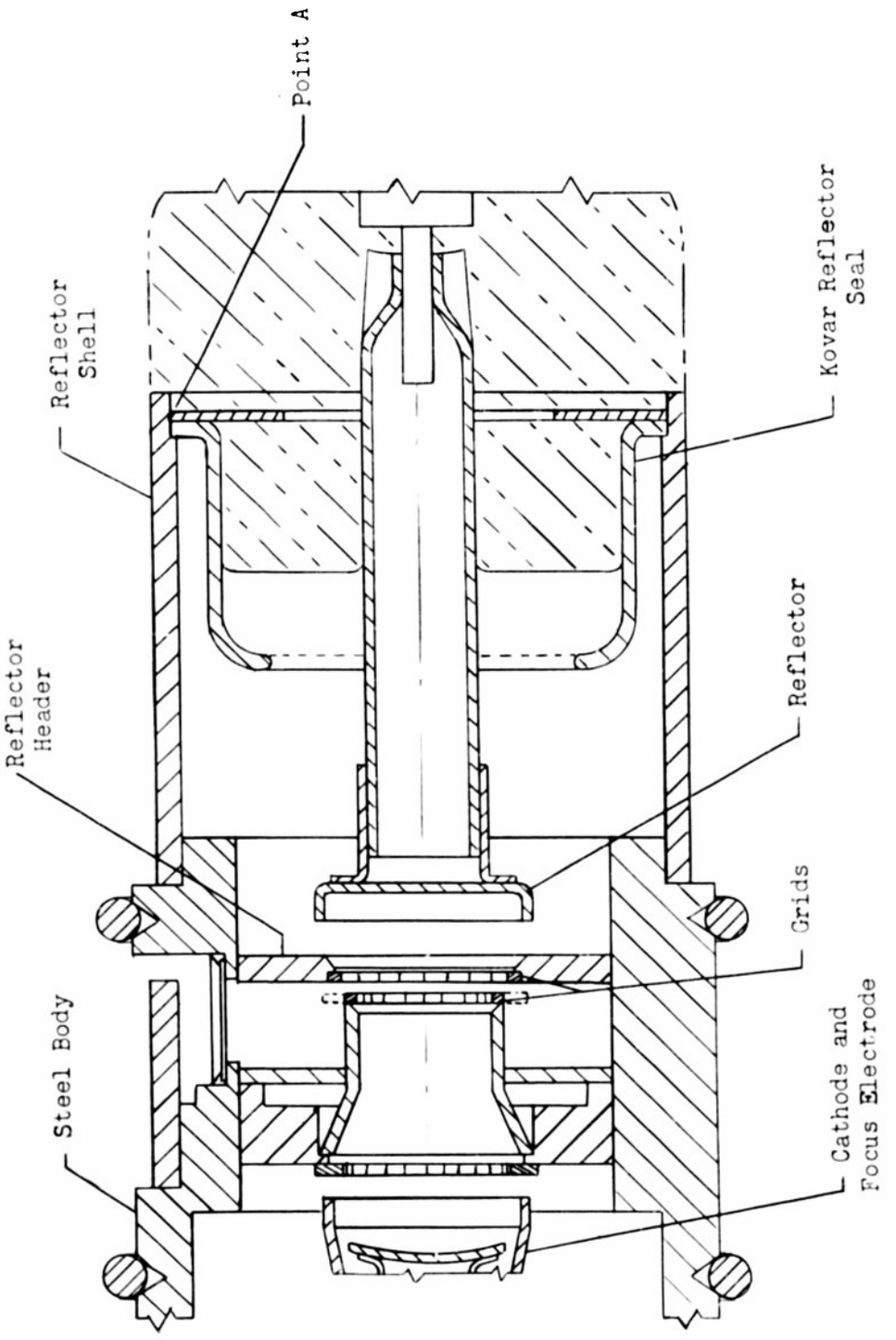

FIGURE 1

PARTIAL CROSS SECTION OF V-52

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